



Pebble Project

NORTHERN DYNASTY MINES INC.

DRAFT ENVIRONMENTAL BASELINE STUDIES 2005 STUDY PLANS

CHAPTER 19. DATA MANAGEMENT AND GIS

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ACRONYMS

AASHTO	American Association of State and Highway Transportation Officials
ABA	acid-base accounting
ACHP	Advisory Council on Historic Preservation
ACL	alternative cleanup level
ADEC	Alaska Department of Environmental Conservation
ADF&G	Alaska Department of Fish and Game
ADNR	Alaska Department of Natural Resources
agl	above ground level
AHRS	Alaska Heritage Resource Survey
AKNHP	Alaska Natural Heritage Program
ANOVA	analysis of variance
APE	area of potential effect
AS	alpine rock and dwarf scrub habitat
ASCI	Alaska Stream Condition Index
ASTM	American Society for Testing and Materials
BEESC	Bristol Environmental & Engineering Services Corporation
BMR	baseline monitoring report
°C	degrees Celsius
CAD	computer-aided drafting
CC	comprehensive stations with continuous-stage monitoring
CIR	color infrared
CQ	continuous discharge
CWOC	comprehensive stations without continuous-stage monitoring
DECD	Alaska Department of Economic and Community Development
DEM	digital elevation model
DNR	Alaska Department of Natural Resources
DO	dissolved oxygen
DOT&PF	Alaska Department of Transportation & Public Facilities
DQOs	data quality objectives
EBD	environmental baseline document
EC	environmental consequences
EIS	environmental impact statement
EPA	U.S. Environmental Protection Agency
FAA	Federal Aviation Administration

FHWA	Federal Highway Administration
FSP	field sampling plan
GIS	geographic information system
GPS	global positioning system
HDR	HDR Alaska, Inc.
HGM	hydrogeomorphic
IEE	Initial Environmental Evaluation
IM	initial monitoring station
JDS	jurisdictional field plts
L	liter(s)
LCNPP	Lake Clark National Park and Preserve
LDN	Land Design North
LM	lowland wet graminoid, moss meadow habitat
LS	lowland low and tall alder/willow scrub habitat
m	meter(s)
MCHTWG	Mulchatna Caribou Herd Technical Working Group
MDC	mine development concept
mg	milligram(s)
ML/ARD	metal leaching/acid rock leaching
mm	millimeter(s)
MODIS	moderate resolution imaging spectroradiometer
MRL	method reporting limit
µm	micrometer(s)
NASA	National Aeronautics and Space Administration
NDM	Northern Dynasty Mines Inc.
NEPA	National Environmental Policy Act
NHPA	National Historic Preservation Act
NOAA	National Oceanic & Atmospheric Administration
NPS	National Park Service
NRCS	Natural Resources Conservation Service
NRHP	National Register of Historic Places
NWI	National Wetlands Inventory
ORP	oxidation reduction potential
PJD	preliminary jurisdictional determination
PSD	prevention of significant deterioration
psi	pounds per square inch
QA	quality assurance
QAPP	quality assurance project plan

QC	quality control
RS	riverine willow scrub habitat
SHPO	State Historic Preservation Officer
SLR	SLR Alaska
SOP	standard operating procedure
SRB&A	Stephen R. Braund & Associates
SS	subalpine dwarf, low, and tall scrub habitat
SWANCC	Solid Waste Agency of Northern Cook County v. U.S. Army Corp of Engineers
SWE	snow/water equivalent
TIN	triangulated irregular network
TOC	total organic carbon
TPH	total petroleum hydrocarbons
UF	upland dwarf scrub, lichen flats habitat
US	upland dwarf, low, and tall scrub habitat
USACE	United States Army Corp of Engineers
USFWS	United States Fish and Wildlife Service
USGS	United States Geological Survey
WMC	Water Management Consultants
WMP	water monitoring plan
WQ	water quality

19. DATA MANAGEMENT AND GIS

Resource Data Inc. (RDI) is providing GIS (geographic information system) and data management services to support the Pebble Project. The GIS and scientific data generated as part of the permitting process are a valuable asset to Northern Dynasty Mines Inc. (NDM). In the short term, NDM will make the data available to the environmental baseline project team. In the long term, the data will support the environmental impact statement and permitting process, and ultimately will support monitoring throughout the life of the Pebble Mine. A sound data management plan will ensure that the data are accurate, timely, and integrated into a multidisciplinary database.

Proactively managing the data will ensure that they are accurate and available when needed. The project strategy calls for a data management process that is completely automated. The plan is to provide data sources with clear requirements for data deliverables and to provide the tools for the data sources to verify compliance prior to delivery.

The data management and GIS scope of work is divided into two sections:

- Support for wetlands/habitat program
- Website and data management

Support for wetlands/habitat program covers managing all the mapping data collected during the baseline studies, creating and loading base-map and Pebble-specific data, providing GIS support for the wetlands study, and providing cartographic services to support the entire project.

Website and data management includes building a central data repository for the project, providing web-based tools to enter and report on project data, and providing tools to upload data into the project database. The website and database will be designed to provide long-term storage of and access to baseline data throughout the life of the mine.

19.1 Support for Wetlands/Habitat Program

19.1.1 Objectives

The objectives of the activities in support for wetlands/habitat program are to:

- Support the habitat-mapping team.
- Support the 2005 field season.
- Maintain the project website.
- Load proposed road and facility data.
- Provide mapping for the powerline project.
- Provide accurate locations for private property.

19.1.2 Proposed Study Plan

The scope of services includes professional services in GIS and data management to support the 2005 Pebble wetlands and habitat-mapping program.

19.1.2.1 Activity 1: Ongoing Support for Wetlands/Habitat-mapping Program

Support will be provided to the wetlands/habitat-mapping team in the wetland delineation and habitat-mapping programs.

The following activities will be required to complete this activity:

- Conduct habitat-data scrubbing (close polygons, remove slivers, etc.).
- Provide analysis of wetland mapping, such as presentation-quality summary tables showing acreage of disturbance, jurisdictional wetland mapping, vegetation type, and HGM classification.
- Provide ongoing support for alternative impact analysis of four different development scenarios.
- Maintain the master data set throughout the mapping process.
- Provide ongoing documentation of GIS data sets and load to www.pebbleproject.com. Documentation is compliant with current FDGC standards.

19.1.2.2 Activity 2: 2005 Wetland Field Season Support

Wetland support will address the following:

- Proposed field options to include 120 more jurisdictional field plots (JDS) with associated functional assessments (based on footprint moves of the mine, etc.).
- Up to 1,050 more rapid functional assessments (one page form with the GPS camera data).
- Additional camera data associated with the detailed field evaluation of mitigation/diversion ditches.
- Up to 120 more JDS in willow thickets.
- SWANCC evaluations with U.S. Corps of Engineers/Environmental Protection Agency.

The following tasks will be required to complete this activity:

- Create two additional global positioning system (GPS) camera scripts to support the additional wetland-data collection effort.
- Create field maps and photo reports to support the wetlands field surveys and data analysis.
- Process photos and photo locations and create a single-point data set which links the digital photos to their sample location.

19.1.2.3 Activity 3: Pebble Website Maintenance

General site maintenance will be conducted to keep the Pebble website environments (Development, Test, and Production) running and in good working order and to protect the integrity of the data contained within the database and website. Tasks required to complete the activity include:

- Applying necessary security patches and performance tuning of servers.
- Performance tuning and maintenance of the Oracle 9i database.
- Minor website source code changes.
- Migration efforts—transferring the website source code from Development to Test and finally to Production.
- Documentation—updates to database Entity Relationship Diagrams (ERDs), updates to website diagrams, and creation/modification of supporting technical documents.
- Creation of a series of administration screens to help administrative users update the site in a more efficient manner. Admin screen types include User Manager, Application Manager, Role Manager, and Site Configuration Manager.

19.1.2.4 Activity 4: Load Facilities and Road Data

Proposed facility and road alignment data will be loaded into the GIS.

19.1.2.5 Activity 5: Extended Mapping for Powerline Project

Public data sets will be gathered and translated into ESRI ArcGIS format to support the addition of the Pebble powerline. Tasks required to complete this activity include:

- Create and process hydrography data from U.S. Geological Survey (USGS) DLG data.
- Acquire and process all existing Alaska Department of Environmental Conservation (ADFG) habitat-mapping for the powerline addition.
- Process borough boundaries, Native corporation boundaries, and township/range/section data for the powerline project.
- Acquire and process the USGS digital land-cover data.
- Incorporate DRG, DOQ data into the GIS.
- Process the existing NWI data for the powerline extension, including adding long species name to the data set.
- Acquire soundings for Cook Inlet and process the soundings into bathymetric contours.
- Process as-yet unidentified additional layers into the GIS.

19.1.2.6 Activity 6: Generate Accurate Native Allotment Data

- The Native allotment data that the project team members are using are approximate and are not considered accurate for location purposes. The data are published from the Bureau of Land

Management (BLM) simply to show that allotments exist in the general area, not to provide accurate location information. The only source of accurate location information for the allotments is the original survey notes. To resolve this issue the team will complete the following activities:

- Gather the survey notes.
- Convert the lot bearings and distances from the notes into Coordinate Geometry (COGO).
- Tie the allotment boundary data to known control points.
- Project the data to Alaska State Plane Zone 5 NAD83.
- Create metadata for the new accurate allotments.

19.1.3 Approach

An NDM GIS environment will be established. Digital and hardcopy data will be acquired and loaded into the GIS for distribution to the project team. For the most part, ArcInfo will be used to create coverages, which will be output as shape (SHP) files. This is the most expedient method to process data, and SHP files are the preferred format for the environmental team. Most of the data that will be loaded into the GIS are available in digital format. Data available only in hardcopy will be digitized. Distribution will be accomplished by transferring media such as CDs and portable hard-disk drives. Smaller files will be published on the project website for download.

19.1.4 Deliverables

Activity	Deliverable Description
1. Ongoing Support for Wetlands/Habitat-mapping Program	Scrubbed wetland map data Summary tables Various maps and reports showing potential impact GIS data documented and loaded to website
2. Ongoing Support for 2005 Wetlands Team	Two new camera scripts Field maps and photo reports Processed photo database
3. Pebble Website Maintenance	Site maintained through 2005 Security control of users in website
4. Load Facilities and Road Data	Proposed facility and roads loaded to GIS
5. Extend Mapping for Powerline Project	Base-map for powerline area including hydrography and hipsography Habitat data in ArcGIS format for powerline project Boundary data for powerline project EROS land-cover data for powerline project USGS DRG and DOQ's for powerline project Fish and wildlife NWI data for powerline project Bathymetry data for powerline project Unidentified data sources to be determined
6: Generate Accurate Native Allotment Data	Accurate spatial locations for private lands

19.2 Database/Website Development/NDM Support

The project website will be further developed with added functionality in uploading, storing, and analyzing data. Additionally, we will provide support for NDM.

19.2.1 Objectives

The objectives of the website and data management activities described in this document are as follows:

- Create a process for managing the sampling process.
- Create additional field forms for capturing field data.
- Support data analysis and reporting.
- Create cartographic map products.

19.2.2 Proposed Study Plan

A wide range of activities are necessary to add the additional functionality to the website and data management system. These activities are described below.

19.2.2.1 Activity 1: E-Chain Integration

The project website will be integrated with the E-Chain product. This integration will create management-level reporting capabilities to provide an audit trail for NDM's tracking of the sampling process. Tasks required to complete the activity include:

- Develop a standard operating procedure (SOP). Collaborate with The Shaw Group to write an SOP that defines how electronic chain-of-custody and the NDM database are to be integrated into sampling, shipping, and laboratory reporting.
- Modify the project website to store E-Chain-generated data.
- Develop management-level reports for tracking the analytical data, including a Chain of Command List Report and a Chain of Command Standard Report.

19.2.2.2 Activity 2: Field Form Modifications

Additional field forms will be added to the project website, and forms created during 2004 will be modified. Tasks required to complete the activity include:

- New Field Form Implementation. Develop three new field forms for the Pebble Mine website, including Habitat Survey Field Form, Habitat Morphology Data Card, and Road Survey Form.
- Existing Field Form Management. Coordinate with last year's field crews to update and refine the existing field forms to more closely match data tracked during the season.

19.2.2.3 Activity 3: Analytical Data Modifications

Tasks required to complete this activity include development of a data set report tool, to be driven by custom views created for outputting data sets needed for analysis.

19.2.2.4 Activity 4: Cartographic Services

Maps and graphics will be provided as needed for use in meetings with agencies. Maps will also be provided for the final documents.

19.2.3 Approach

The project team will develop the new functionality on the same technology as the existing website. Processes will be developed to facilitate capturing the data in the master NDM repository. Cartographic products will be generate in ArcGIS and will be available in digital format via the project website.

19.2.4 Deliverables

Activity	Deliverable Description
1. E-Chain Integration	Standard Operating Procedure for E-Chain and the NDM project Ability to load E-Chain data to project website COC List Report COC Standard Report Missing Sample Report Lab Analysis vs. Requested Method Report Actual Samples Collected vs. Actual Results Report
2. Field Form Modifications	Habitat Survey Field Form Habitat Morphology Data Card Road Survey Form Field forms modified to include unique findings of the NDM project
3. Analytical Data Modifications	Ability for users to define and extract analytical data to MS Excel
4. Cartographic Services	Cartographic products as requested by NDM